IN THE SPECIFICATION:

Please amend paragraph number **[0003]** as follows:

[0003] Conventional IC devices, such as BGA, TSOP, SOP, SOJ, etc. packages, generally comprise a semiconductor die electrically connected to a plurality of electrical leads that is encased within an encapsulant material, a portion of each of the electrical leads extending from the encapsulant material and configured for establishing electrical connections between the semiconductor die and external components or higher-level packaging. An exemplary embodiment of a conventional BGA package is shown in FIGS. 1 and 2. The conventional BGA package 10 includes a semiconductor die 20 secured to a die-attach pad 35 formed on an upper surface 31 of a substrate 30, which may also be termed an ~~"interposer".~~ "interposer." The BGA package 10 also includes a plurality of electrical leads 40 adapted to provide electrical communication between the semiconductor die 20 and one or more external components (not shown). The semiconductor die 20 and at least a portion of each electrical lead 40 may be encased by an encapsulant material 50. The conventional BGA package 10 may be a memory device, such as a DRAM chip, a processor, or any other integrated circuit device known in the art.

Please amend paragraph number **[0006]** as follows:

[0006] To attach and electrically connect the conductive balls 41 of the BGA package 10 to a ~~substrate such~~ substrate, such as, for example, an MCM carrier substrate or a burn-in ~~board the~~ board, the substrate is configured with a plurality of contact pads arranged in a number of contact pad arrays. Each contact pad array includes a number of contact pads arranged in a pattern corresponding to the pinout of the BGA package 10. The conductive balls 41 of the BGA package 10 may be formed of solder or a conductive or conductor-filled epoxy. If solder, the conductive balls 41 are reflowed to connect to the contact pads of the contact pad array on the substrate. If epoxy, the conductive balls 41 may be first heated to a tacky "B" stage to adhere to the contact pads, and then further heated to completely cure the epoxy to a "C" stage. A substrate may include a plurality of IC devices mounted thereto, wherein

each of the IC devices is permanently attached to a corresponding contact pad array on a surface of the substrate. By way of example, an MCM may be a memory module comprised of a one-piece carrier substrate having opposing surfaces, with one or both of the opposing surfaces of the carrier substrates including multiple contact pad arrays and a plurality of IC devices, such as BGA and SOJ packages, mounted thereto.

Please amend paragraph number **[0007]** as follows:

[0007] During the fabrication of an IC device, the IC device may be subjected to individual component-level testing, such as burn-in and electrical testing. An IC device that exhibits a desired level of performance during ~~component level~~ component-level testing is generally referred to as a "known good device" or "known good ~~die"~~ die," while an IC device failing to meet minimum performance characteristics may be referred to as a "known bad device." After component-level testing, the IC device may be assembled into higher-level packaging, such as an MCM, and again subjected to testing. Testing of higher-level packaging such as an ~~MCM – referred~~ MCM, referred to herein as module level ~~testing – may~~ testing, may include burn-in, electrical characterization and performance evaluation, as well as other desired electrical testing.

Please amend paragraph number **[0008]** as follows:

[0008] If an MCM fails to exhibit minimum operating characteristics during module level testing, an IC device causing the ~~failure – which~~ failure, which may have previously been identified as a "known good device" during ~~component level testing – must~~ component-level testing, must be removed from the MCM and replaced. Also, it may be desirable to introduce a "known bad" IC device into an MCM for module level testing in order to observe the electrical characteristics of the MCM with the "known bad" IC device, or to observe the electrical characteristics of the "known bad" IC device at the module level. After module level testing is complete, the "known bad" IC device must be removed from the MCM and replaced. Thus, although individual IC devices are typically tested at the component level, it is desirable to

subject IC devices to further testing at the module level, as a "known good device" may fail at the module level and, further, because incorporation of a "known bad device" into an MCM may be useful in module level testing.

Please amend paragraph number **[0009]** as follows:

[0009] To test IC devices in a higher-level environment, module level testing is generally performed after the IC devices are assembled into and permanently attached to, for example, an MCM carrier substrate. Thus, if an IC device must be removed from an MCM after module level testing, the permanent electrical bonds between the electrical leads of the IC ~~device — for~~ device, for example, the conductive balls 41 of the conventional BGA package ~~10 — and~~ 10, and the contact pads on the MCM carrier substrate must be severed. Severing these permanent electrical ~~bonds — which,~~ bonds, which, as noted previously, typically comprise solder or conductive ~~epoxy — may~~ epoxy, may cause both heat-induced and mechanical damage to the MCM carrier substrate and conductors, to the electrical leads and electrical bonds of the IC devices remaining on the MCM, and to other electrical components mounted on the MCM.

Please amend paragraph number **[0010]** as follows:

[0010] Also, it may be necessary to remove an IC device from a substrate to achieve an upgrade. For example, as technological advances are made by IC device manufacturers, it is often desirable to replace an IC device mounted to a substrate with a next-generation IC device exhibiting improved performance characteristics. To replace an obsolete IC device mounted to a ~~substrate — such~~ substrate, such as the carrier substrate of an MCM comprising part of, for example, a personal ~~computer — the~~ computer, the permanent electrical bonds between the electrical leads of the obsolete IC device and a plurality of contact pads on the substrate must be severed, which may cause both ~~heat induced~~ heat-induced and mechanical damage to the substrate and to other IC devices remaining on the substrate.

Please amend paragraph number **[0012]** as follows:

[0012] Use of non-permanent electrical connections between the electrical leads of an IC device and a contact pad array of a substrate can, however, itself cause problems during module level testing and/or at final assembly. Non-planarities in the substrate, in the conductors forming a contact pad array, or in the IC device itself, ~~may — in~~ may, in the absence of a permanent bonding ~~agent — result~~ agent, result in poor electrical contact between an electrical lead of the IC device and a corresponding contact pad on the substrate. For example, non-planarities in the substrate 30 of the BGA package 10, as well as inconsistency in size of the conductive balls 41, may result in unreliable electrical contact between the conductive balls 41 and the contact pads of a substrate in the absence of a permanent bonding agent. Similarly, for other types of IC devices, such as the SOJ package, deflection of their electrical leads as they come into contact with the contact pads on the substrate ~~may — again,~~ may, again, in the absence of a permanent bonding agent such as solder or conductive ~~epoxy — result~~ epoxy, result in poor electrical contact. Poor electrical contact resulting from ~~non-planarities~~ non-planarities and/or lead deflections may produce unreliable test data during module level testing or prohibit the acquisition of any meaningful test data, and such poor electrical contact may result in non-functional assembled IC device components or assembled IC device components which do not comply with customer or industry specifications. In addition, the use of non-permanent electrical connections between the electrical leads of an IC device and a contact pad array may result in an overly long electrical path with increased inductance, a characteristic which degrades signal integrity at high device operational speeds.

Please amend paragraph number **[0034]** as follows:

[0034] ~~FIG.14A~~ FIG. 14A shows a cross-sectional view of a spring contact according to an embodiment of the invention having the spring coils in contact;

Please amend paragraph number **[0040]** as follows:

[0040] Each spring contact 120 is configured to engage and resiliently bias against an individual conductive ball 41 of the BGA package 10 in order to establish physical and electrical contact between the conductive ball 41 and the spring contact 120. Referring to FIG. 5, the conventional BGA package 10 is shown mounted to the substrate 160. Each conductive ball 41 of the BGA package 10 is engaged with and specifically, as illustrated, at least partially received within a contact portion 122 of a corresponding spring contact 120 disposed on the substrate 160, the array 121 of spring contacts ~~120 – as~~ 120, as well as the array 171 of apertures ~~170 – being~~ 170, being arranged in a pattern matching the pin-out of the conductive balls 41 extending from the BGA package 10. Thus, an electrical connection is formed between each conductive ball 41 of the BGA package 10 and one of the spring contacts 120 disposed on the substrate 160. Additionally, compression of the spring contacts 120 as BGA package 10 is disposed against substrate 160 will help to reduce inductive electrical effects as the spring contacts 120 are compressed and laterally adjacent coils or segments thereof are placed in mutual contact to effectively shorten the electrical path and reduce inductance.

Please amend paragraph number **[0041]** as follows:

[0041] To secure the BGA package 10 to the substrate 160 and to create both physical and electrical contact between each conductive ball 41 and a mating spring contact 120, the BGA package 10 is held against the substrate ~~160 – and~~ 160, and biased against the spring contacts ~~120 – by~~ 120, by a clamping element 90. The clamping element 90 illustrated in FIG. 5 may be any suitable clip or clamp known in the art adapted to secure the BGA package 10 to the substrate 160. For example, the clamping element 90 may comprise a stab-in-place clip 95 having one or more resilient tabs or prongs 96 configured for insertion into corresponding holes 164 in the substrate 160. The resilient tab or tabs 96 are retained by the corresponding hole or holes 164 to secure the BGA package 10 to the substrate 160 and to bias the conductive balls 41 thereof against the spring contacts 120. Typically, such stab-in-place type ~~clips~~ clips 95 are injection molded from plastic materials and are relatively inexpensive. In addition to the

foregoing, it is also contemplated that various apparatus disclosed and claimed in copending U.S. patent application Serial No. 09/478,619, filed January 5, 2000 and assigned to the assignee of the present invention, may be employed to secure BGA package 10 to the substrate 160. The disclosure of U.S. patent application Serial No. 09/478,619 is hereby incorporated herein by reference.

Please amend paragraph number **[0042]** as follows:

[0042] Referring to FIG. 6, each spring contact 120 includes a contact portion 122 and a base portion 124. The contact portion 122 is configured to engage and resiliently bias against a conductive ball 41 of the BGA package 10 and to thereby establish physical and electrical contact with the conductive ball 41. The contact portion 122 generally comprises a coil-type compression spring, as is shown in FIGS. 4 through 6. The base portion 124 is configured to secure the spring contact 120 within its mating aperture 170 and to establish electrical contact between the spring contact 120 and the substrate 160. The base portion 124 may comprise an S-shaped ~~cantilever type~~ cantilever-type spring, as is shown in FIGS. 4 through 6; however, the base portion 124 may comprise any other suitable shape and configuration, so long as the base portion 124 can be secured in the aperture 170 and form electrical contact therewith.

Please amend paragraph number **[0043]** as follows:

[0043] The contact portion 122 may be further configured to align, or to assist in aligning, the conductive ball 41 relative to the spring contact 120. For example, as shown in FIG. 6, the contact portion 122 may comprise a generally hemispherically or conically shaped coil spring providing a cup or recess 123 for receiving at least a portion of the conductive ball 41. The cup or recess 123 provided by the contact portion 122 functions to guide or align the conductive ball 41 relative to the spring contact ~~120 – and~~ 120, and relative to the substrate ~~160 – as~~ 160, as the conductive ball 41 engages the contact portion 122 of the spring contact 120. The contact portion 122 may be of any other suitable shape adapted to align the conductive ball 41 relative to the spring contact 120.

Please amend paragraph number **[0045]** as follows:

[0045] To secure a spring contact 120 within its mating aperture 170 of the substrate 160, the base portion 124 of the spring contact 120 is inserted into the retaining portion 174 of the aperture 170. The base portion 124 of spring contact 120 makes contact with the retaining portion 174 of aperture 170 and mutual contact forces ~~therebetween – such~~ therebetween, such mutual contact forces resulting from deflection of the base portion 124 upon insertion into the retaining portion ~~174 – create~~ 174, create frictional forces that retain the spring contact 120 within the aperture 170. Alternatively, the base portion 124 of a spring contact 120 may be secured within the retaining portion 174 of a mating aperture 170 using a permanent bonding agent, such as solder or a conductive epoxy.

Please amend paragraph number **[0047]** as follows:

[0047] The seat portion 172 may be further configured to align, or assist in aligning, the conductive ball 41 relative to the spring contact 120. For example, as shown in FIG. 6, the seat portion 172 may comprise a generally hemispherical recess. As the conductive ball 41 engages the spring contact 120, the hemispherical recess 123 guides the conductive ball 41 (shown in dashed line in FIG. 6) into contact with the contact portion 122 of the spring contact 120. Therefore, such a hemispherical recess 123 functions to align, or assist in aligning, the conductive ball 41 relative to the spring contact 120, as well as relative to the substrate 160. The seat portion 172 may be any other suitable shape adapted to guide the conductive ball 41 into contact with the contact portion 122 of a spring contact 120.

Please amend paragraph number **[0051]** as follows:

[0051] The spring contact 320 and mating aperture 370 shown in FIG. 8 are, therefore, similar to the spring contact 120 and aperture 170 shown in FIGS. 3 through 6; however, the contact portion 322 of spring contact 320 comprises a generally cone-shaped coil spring having an apex or point 323 for contacting and/or penetrating the outer surface of a conductive ball 41

(shown in dashed line in FIG. 8). The apex or point 323 can penetrate or puncture any layer of oxide or other contaminants formed on the exterior surface of conductive ball 41, such that reliable electrical contact can be established between the spring contact 320 and the conductive ball 41. It should be understood that any suitable type ~~tip~~ apex or point 323 capable of penetrating or puncturing a layer or layers of oxide or contaminates on the conductive ball 41 may be used. Also, the seat portion 372 of aperture 370 comprises a generally cylindrical shape for aligning the conductive ball 41 relative to the spring contact 320. It should be noted that, for the embodiment shown in FIG. 8, alignment of the conductive ball 41 relative to the spring contact 320 and substrate 360 is performed primarily by the seat portion 372 of the aperture 370.

Please amend paragraph number **[0056]** as follows:

[0056] Also, in a further embodiment of the invention, the spring contacts 120, 220, 320, 420, 520, 620 may ~~include – or~~ include, or be constructed from a resiliently conductive wire that ~~includes – one~~ includes, one or more contact elements configured to wipe away and/or puncture a layer of oxide and/or other contaminants formed on an exterior surface of a conductive ball 41. For example, as shown in FIG. 12, a spring contact 720 may be constructed from a wire material exhibiting a rectangular cross-section and having a plurality of sharp edges 728 that may function as contact elements. The sharp edges 728 can impinge against and move over the exterior surface of a conductive ball 41, effecting a scraping or penetrating action to remove oxides and other contaminants therefrom or to reach interior portions of conductive ball 41. Alternatively shaped wire, such as one having a triangular cross-section, is also believed suitable for this purpose.

Please amend paragraph number **[0063]** as follows:

[0063] Those of ordinary skill in the art will appreciate that the various features of the spring contacts 120, 220, 320, 420, 520, 620, 720, 820, 920a, 920b shown and described with respect to FIGS. 3 through 14 may be used in any suitable combination. A spring contact having any type of contact ~~portion – i.e.,~~ portion, i.e., a generally ~~hemispherically or conically~~

hemispherical or conical shape, a generally ~~cylindrically~~ cylindrical shape, or a ~~cone shape~~ cone shape having an ~~apex -- may~~ apex, may be used in conjunction with any type of ~~aperture -- i.e.,~~ aperture, i.e., one having a ~~hemispherical~~ hemispherically shaped seat portion, a ~~conical~~ conically shaped seat portion, a ~~cylindrical~~ cylindrically shaped seat portion, or no seat portion. For example, a ~~cone shaped~~ cone-shaped contact portion having an apex (see FIG. 8) may be used with an aperture having a hemispherical shape (see FIG. 6) or a conical shape (see FIG. 7).

Please amend paragraph number **[0064]** as follows:

[0064] Also, for any spring contact according to the present invention, electrical contact between a spring contact and mating aperture formed in a substrate may be established according to any of the embodiments described ~~herein -- i.e.,~~ herein, i.e., a layer of conductive material on an interior wall of the aperture in conjunction with a conductive trace on a surface of the substrate, a conductive filler material within the aperture in conjunction with a conductive trace on a surface of the substrate, a layer of conductive material on an interior wall of a hole partially extending into the substrate in conjunction with a conductive trace on a surface of the substrate, or a layer of conductive material on an interior wall of a hole partially extending into the substrate in conjunction with an intermediate conductive plane of the ~~substrate -- or~~ substrate, or any combination thereof. For example, a conductive filler material (see FIG. 7) may be used in conjunction with an intermediate conductive plane (see FIG. 11) or, alternatively, a spring contact may be configured to establish direct contact with an intermediate conductive plane.

Please amend paragraph number **[0068]** as follows:

[0068] A spring contact according to the present invention having been herein described, those of ordinary skill in the art will appreciate the many advantages of the present invention. The spring contacts of the present invention provide robust and reliable non-permanent electrical connections between a lead element or elements extending between an IC device and a substrate, such as an MCM carrier substrate. The electrical connection provided by such a spring contact can be easily severed without ~~mechanical or~~ mechanical- or

heat-induced damage. Also, use of spring contacts according to the invention enables IC devices to be directly attached to a substrate, without the need for relatively expensive sockets. Further, any of the spring contacts described herein may be used for testing ~~applications -- such~~ applications, such as for the temporary mounting of IC devices to a burn-in or other test ~~board -- or~~ board, or for final assembly of an electrical component, such as an MCM.